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THE THAMES ESTUARY

I. HYDROGRAPHIC HISTORY

The earliest reliable records for determining the hydrographic history of the approach channels are the surveys of Murdock Mackenzie (1774-78), Graeme Spence (1800) and Thomas (1810). The work of these three surveyors gave the first complete picture of the hydrography of the Thames Estuary. All the main N.E. - S.W. aligned channels are in evidence, with intervening sandbanks. The depths in such channels as the Barrow Deep, Black Deep etc., have remained fairly constant. Thus the earliest surveys show depths of 12 fathoms in the West Swin, these being closely comparable with the findings of the latest surveys. Similarly there has been little variation in the depths in Barrow Deep, Black Deep and Knock Deep, at least in their more seaward positions.

In the Middle Deep and East Swin channels however, changes have resulted from the elongation and contraction of the Middle Sand, Separating the two. Captain Bullock's survey (1844-49) shows a bar of least depth 24 feet joining the N.E. extremities of the Middle Sand and East Barrow Sand. By 1863 when the area was resurveyed by Staff Commander Calver, the bar had given place to a distinct channel with least depth 33 feet. Captain Tizard's survey of 1889 showed a least depth of 36 feet. Since then, the deepening has slowed considerably but the latest survey (H.M.S. Challenger 1939) found a minimum depth of 30 feet in the channel.

At the S.W. extremity of the Middle Sand, the reverse has taken place in the past 150 years. The survey of Graeme Spence in 1800 showed a least depth of 36 feet in passing from the East Swin to the West Swin channel. This passage has gradually shoaled due to the extension in a S.W. direction of the Middle Bank, so that the latest survey found depths 13 - 17 feet.

The relative stability of the N.E. - S.W. aligned channels is not in evidence when the hydrographic history of the swatchways, which cross the sand banks transversely, is considered. At various times swatchways have developed, deepened, shoaled and then entirely disappeared. A case in point is the swatchway which developed across the northern end of Sunk Sand, where formerly there existed a distinct channel of depth 22 feet (Captain Bullock's Survey 1844-49) the latest survey shows drying banks (4 feet above chart datum) in the same position.

The most studied of the swatchways is the one now known as the Edinburgh Channels, (the main changes of which are recorded in tracing series A and B.) The first record of it is an old chart of 1794 where it is named Smugglers Swatch with least depth 9 feet. When surveyed by Thomas in 1810 and renamed "Thomas's New Channel", it was a narrow passage of least depth 30 feet, between the Flat of the Girdler and Long Sand. With Captain Bullock's resurvey of the channel in 1839 it had narrowed considerably and shoaled to 23 feet. A new channel had however opened to the S.W. of the former one, although its entrance to the Black Deep was narrow and had a shoal depth of 18 feet. This new channel appears as an inlet on Thomas's Chart. That Bullock's Channel (as this new channel was called) continued to deepen and widen is shown by Staff Commander Calver's survey of 1862. The least depth in the centre of the channel was about 40 feet. Thomas's New Channel had finally closed, there being a depth of only 1 foot where formerly the channel had been cut.

About 1880 the history of the new deep and wide channel entered a new phase. Early in 1882 Staff Captain Tizard surveyed the channel (once more renamed "Duke of Edinburgh", after the Master of Trinity House) and found a shoal patch 30 feet where formerly (1862 survey) a hole of 65 feet deep had existed. By 1888, when it was examined again, further shoaling had taken place and the least depth was now 22 feet. This shoal lying in the centre of the channel was named Shingles Patch.

The subsequent hydrographic history of the Edinburgh Channels was largely concerned with the growth of Shingles Patch. By 1910 (survey of H.M.S.S. "Triton" the shoal had extended and there was only 4 feet of water over it. Two distinct channels were now in evidence, the North Edinburgh and the South Edinburgh. Of

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the two the South Edinburgh was the deepest, but suffered from being narrow, the Shingles Patch lying nearer to Shingles Sand than Long Sand. The shoaler (least depth 29 feet) but wider, North Edinburgh Channel was used by deep draught vessels at this time. A survey of 1926 showed a tendency towards a slight deepening of this channel with the "Shingles" Patch shifting to the N.W. assisted by the growth of a shoaler bar across the North Edinburgh Channel entrance.

The recent history since 1926 is summarized in Tracing Series B. These show the continued shifting of the Shingles Patch in a northward direction whilst extending along the length of the swatchway. The shoaling continued until in 1933 a survey disclosed drying sand on Shingles Patch. This has since become more extensive. The shifting northward of the Shingles Patch, towards the Long Sand, has had the effect of narrowing but at the same time deepening the North Edinburgh Channel at least in its western approaches (where formerly there was a tendency for the growth of a bar.) The latter tendency appears to have been transferred to the eastern end of the North Edinburgh for the latest survey (1945) shows an extension southwards of the Long Sand. This coupled with the S.E. extension of the Shingles Patch has had the effect of considerably narrowing the eastern entrance to the North Edinburgh Channel.

This is the state of this swatchway at the present time. The past record makes it difficult to speculate on the future but one is tempted to suggest the closing of the North Edinburgh Channel to deep draught vessels. Continued shoaling here would mean increased tidal energy in the South Edinburgh Channel and so it is unlikely that the swatchway as a whole will entirely close. In this connection a depth of 70 feet was found in the 1945 survey, of the Edinburgh Channels.

Another prominent swatchway is the Alexandra Channel. Here the hydrographic history is not nearly so complete. The first reliable survey of the area was undertaken by Murdock Mackenzie round about 1775. There is no channel shown in this position, the patch of sand known as the Girdler extending without a break towards the north-east. At the site of the present channel there were depths of less than a fathom. By 1840, when surveyed by Captain Bullock, a channel had begun to develop from the East, but a bar of least depth 9 feet still connected the West and East Girdler (the present Shingles). Staff Commander Calver's survey of 1862 showed that a distinct channel of least depth 20 feet had been cut between the Girdler and East Girdler. The channel was still narrow and in this connection it persisted for a great length of time. Thus Captain Tizard's survey of 1888 still showed a narrow channel less than half a mile wide although it had deepened slightly. Since 1888 the channel has remained fairly stable with a tendency to widen in consequence of change in the limits of the Girdler.

In reviewing the recent hydrographic history, one is tempted to inquire of the probable origin and subsequent development in a broader aspect of such structures as are encountered in the Thames Estuary. Any attempt however must of necessity be highly speculative in the present state of knowledge. Sandbanks and channels may develop in any one of the following ways, (a) differential sedimentation, (b) submergence of structures formerly built to or above water level, (c) differential wave or current scour, (d) the combine sub aqueous wave and current redistribution of a fairly uniform sheet of sediment. The last hypothesis appears to be most satisfactory applicable to this area, although (c) may be operative in certain parts of the estuary.

That this area of the South North Sea was dry in recent geological time is an accepted fact. Submergence possibly coincided with the assumption of the Strait of Dover of its present form (dated 5000 B.C.) and the initiation of the present system of tidal streams. The N.E. - S.W. aligned channels and sandbanks formed in consequence of this. The main tide enters the North Sea between Scotland and Norway. A secondary tide enters from the Strait of Dover later. An amphidromic system occurs in the Flemish Bight and radiating from this the tide range increases in all direction. Thus the inner estuary has a greater tidal range than the outer, other things being equal. The radiation of tidal energy from the amphidromic point would cause the tidal streams to assume a N.E. - S.W. direction and these would redistribute a uniform sediment of a recently submerged landmass. Small channels once established would be deepened, the scoured material mainly fine sand seeking the intervening areas and assuming a form in the same

direction as the tidal stream. That tidal currents with a velocity of 2 knots per hour to erode, transport sand and even the finer grades of gravel, is an accepted fact.

In addition to tidal stream influence the work of waves has undoubtedly contributed much to the present form. In addition to their ability to transport coarser material they are more constructive than tidal currents, and can build above normal sea level. J. Borley who has studied the distribution of marine sediments in the North Sea contends that waves are effective at least to a depth of 20 fathoms. This their importance cannot be underestimated. In this connection also it is significant that, according to T. Marsh, the Thames Estuary is affected by a direction of maximum fetch (i.e. length of water of which the wind blows) stretching in a N.E. S.W. direction from off the North Holland coast. The present form of the coastline bordering the Thames estuary may also have a bearing in the alignment which the sandbanks take.

The swatchways are rather special channels and can be attributed in the main and tidal stream action. The tide entering from the Strait of Dover is later than the North Sea tide and reaches the Thames Estuary when the latter is on the ebb. In direction it is transverse to such long sandbanks as Long Sand etc. The spilling of tidal water across these sands would, in the first instance, cut shallow channels which were subject later to more localised tidal stream action with consequent deepening. This deepening appears to proceed until a depth equilibrium is established between the swatchway and the main channels it connects. Thus the greatest depth (64 feet) in the Edinburgh Channels closely corresponds to depths in the Black Deep. This figure may be taken as the minimum depth of the sands. There is no evidence of a solid foundation upon which the sands rest, certainly not of a chalk base as suggested by some.

Although the swatchways have such a variable history, they are essential elements of the hydrography, the closing up of one in the past has inevitably meant the opening up or deepening of a less prominent one.

There is little conclusive evidence of the effect of wrecks upon the channels. Such surveys as have been undertaken since the end of the War do not suggest alteration of the Channels due to this cause, although it is as yet too early to formulate a definite statement on this point. It is true that the North Edinburgh Channel has shoaled and narrowed in its eastern extremity but this is most likely due to natural causes. In general the effect of wrecks is determined by local conditions, in some areas shoals may arise in consequence, in others deep holes are formed in the vicinity.

II THE BLACK DEEP SPOIL GROUND.

Survey records of the Black Deep show that dumping in this area has not caused any serious limitations to the channel. The dumped material is subject to tidal stream scour, flood and ebb the velocity of which reaches over 2 knots at the surface. Favourable considerations in the choice of site in addition to the strong tidal scour are the depth of over 10 fathoms in places, the proximity to land and also the fact that the Black Deep is not lighted or buoyed in its seaward position, not being very much used for navigation.